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## Electronic patient portal utilization by neurology patients and association with outcomes

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### Abstract

Existing literature on electronic patient portals demonstrates mixed findings for portal user demographic patterns and relationships between portal usage and clinical outcomes. This study sought to determine characteristics of portal users specific to a neurology patient population and examine whether usage predicted decreased clinic visits and risk of hospitalization. A cross-sectional analysis on 13,483 patients seen at a tertiary neurology outpatient clinic over a 1-year period found significant associations between demographics, and interactions between age, sex, and race. Black and Hispanic patients were less likely to be portal users. While females had higher odds of portal usage overall, their probability decreased with increasing age. Portal users had higher rates of clinic utilization but no difference in hospitalization risk. These results highlight demographics that may need strategic targeting to increase portal uptake and the need for other interventions for populations more likely to experience health events resulting in hospitalization.

### Keywords

electronic portal; health information technology; health services research; neurology practice; patient portal

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Author contributions

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Declaration of conflicting interests

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## Introduction

Patient portals are electronic resources that allow patients to access health-related information such as prescriptions, appointments, and test results.<sup>1,2</sup> Features can include direct communication to providers and modules for managing chronic diseases.<sup>3</sup> Rising healthcare costs, as well as the possibility of being assessed financial penalties, are motivating healthcare facilities to engage in value-based initiatives and reduce preventable incidents such as readmissions and hospital-acquired infections.<sup>4,5</sup> Studies show that patient engagement with online patient portals significantly supports this aim.<sup>6-8</sup> Portal usage has been associated with increase in medication adherence, health literacy, patient engagement, and chronic disease self-management.<sup>9-13</sup> It is estimated that a substantial number of in-person healthcare office visits, particularly follow-up appointments for established patients, may be effectively handled through virtual means<sup>14</sup> such as a patient portal, with no difference in the quality of the visit but with increased patient satisfaction due to convenience.<sup>15</sup> However, portal utilization in other studies has been linked to an increase in healthcare utilization<sup>16</sup> and an increased risk of 30-day readmission.<sup>17</sup>

In addition to the presumed benefits for patients, the Centers for Medicare & Medicaid Services (CMS) offers financial incentives for eligible healthcare facilities to provide patient portal services.<sup>18</sup> Despite this resource allocation, the question remains whether portal usage corresponds to improvements in clinical outcomes or decreases in clinic service use. Prior studies have not been able to unequivocally define specific population demographics most likely to use portals and distinguish from those who may need more targeted interventions.<sup>7,13,19-21</sup> Some evidence, though limited, is available for subspecialty populations such as individuals with diabetes and other chronic conditions,<sup>8,10-12</sup> low-income older adults,<sup>21</sup> kidney and liver transplant patients,<sup>22</sup> orthopedic patients,<sup>23</sup> and individuals affected by cancer.<sup>24</sup> In our study, we aimed to identify patient characteristics and care implications associated with portal usage among neurology patients of a large, tertiary care and referral center.

In this setting, an electronic health record system (Epic Systems Corporation) and associated patient portal (MyChart) were fully implemented in our clinics by 2013. Efforts to engage patients with their own portal have been diverse and multi-pronged. These include one-on-one assistance with portal activation provided by undergraduate student interns, which began in 2017. Other efforts include marketing materials within clinics and the hospital, printing alpha-numeric activation codes on pre- and post-visit summaries, and 1-click electronic activations. Since implementation, this is the first investigation at our institution to examine whether recruitment activities have been evenly successful among patient subpopulations and how portal use relates to clinic service usage.

## Methods

The study used a cross-sectional sample of patients ages 18 and older seen in the UF Health Neurology Clinics (general neurology and movement disorders) between July 1, 2016, and June 30, 2017. Patients were classified as portal “users” if they had ever logged in to use the service during the study timeframe; otherwise they were classified as “non-users” of

the portal. International Classification of Diseases, 10th Revision (ICD-10) codes were used to determine which diseases to include in the overall statistical models and the top 3 most common diagnoses were chosen (Parkinson's, multiple sclerosis, and epilepsy).

Multivariate logistic regression was used to model the likelihood of patient portal utilization and hospitalization. Predictor variables of interest included age, sex, self-reported race/ethnicity, residential distance from clinic, scheduling area, diagnosis, count of clinic visits, and portal user status. Poisson regression was used to model the number of clinic visits, with predictor variables being portal user status, age, sex, self-reported race/ethnicity, distance from clinic, and diagnoses. All diagnoses were coded individually as presence or absence of Parkinson's, multiple sclerosis, and/or epilepsy. The data on the number of clinic visits were corrected for over-dispersion among patients according to the multiple predictor variables. Interaction effects among age, sex, and race were explored in each regression analysis and the receiver operating curve (ROC) of each logistic regression model was calculated to assess their predictive ability. All data were analyzed using SAS v9.4 (SAS Institute, Cary, NC).

All data were gathered retrospectively from patients' electronic medical records through a records request to UF Health Decision Support Services (DSS). The records request included information on patient demographics, diagnoses, zip code, login dates with total login time for each encounter, and dates of communications with providers.

Anonymized data can be shared by request from any qualified investigator. Permission to conduct this study was obtained from the University of Florida Institutional Review Board and a waiver of informed consent was granted.

## Results

The study sample included 13,483 adult patients totaling 25,486 clinic visits over the study period. Forty-two percent of the patients were portal users and 58 percent were non-portal users. Fifty-six percent of the cohort were females. Four of five patients were white, and 94 percent were non-Hispanic. The average age of the patients was 55 years (SD = 18 years). Thirty percent of the patients lived within 20 miles of the clinic and about 70 percent lived 21 miles away or farther.

Most patients (89.6%) had one to three clinic visits during the study period and 0–2 prescription medications at the time of the first office visit (75.9%). Parkinson's disease and epilepsy were the most common diagnoses in the patients' charts (13% and 11%, respectively). Table 1 displays the characteristics of the cohort.

### Predicting portal usage

In the logistic regression analysis used to assess characteristics of portal users versus non-users, all variables used as predictors in the model were statistically significant at the 95% confidence level: sex, age, race, ethnicity, diagnosis, clinical scheduling area, and patient distance in miles from the clinic. Demographically, there were significant interaction effects involving age, sex, and race (Figures 1, 2). Females were more likely to be portal users

than men, but their likelihood decreased with age, while portal use by men stayed relatively stable (Figure 2). Interaction effects between age and race showed that black patients were significantly less likely to be portal users, with a substantial decrease with age (Figure 1). Overall, Hispanics showed 30 percent decreased odds of being portal users compared with non-Hispanic patients (odds ratio (OR) = 0.7) (Table 2). Patients who lived 21–50 miles away from the clinic had the lowest odds of any distance category to be portal users (OR = 0.5).

Regarding subspecialty classification of patients, general neurology patients had 34 percent higher odds of being portal users compared with movement disorders patients (OR = 1.34). Patients with Parkinson's disease and multiple sclerosis were much more likely to be portal users (64% and 34% increased odds, respectively), while patients with epilepsy had 30 percent lower odds than those without an epilepsy diagnosis. Increasing the number of medications present on first clinic visit decreased the odds of being a portal user by a factor of 0.97. An increase in the number of clinic visits by one increases the odds of being a portal user by 26 percent. The overall ROC of this model was moderately low at 0.66.

### Factors associated with hospitalization

Factors associated with hospitalization were distance from the clinic, ethnicity, number of prescriptions, scheduling area, diagnoses of multiple sclerosis and Parkinson's disease, and interaction between age and race (Table 3). Patient portal usage was not significantly associated with odds of hospitalization after adjusting for other factors.

While patients who lived 21–50 miles away from the clinic did not differ significantly in odds of hospitalization compared with patients who lived 20 miles or closer, those who lived more than 50 miles away were less likely to be hospitalized, with a possible “dose-dependent” effect (OR = 0.76 for 51–100 miles and OR = 0.63 for > 100 miles).

Demographically, Hispanic patients had higher odds of being hospitalized compared with non-Hispanics (OR = 1.38). The interaction between age and race was significant, with black patients being more likely to be hospitalized as age increases and patients classified as “other ethnicity” being significantly less likely with increasing age.

Regarding clinically related factors, increasing the number of prescriptions by one decreased the odds of hospitalization by about 12 percent. General neurology patients have odds of hospitalization about twice as high as movement disorders patients (OR = 2.19). Multiple sclerosis and Parkinson's patients had odds 39 percent and 23 percent lower, respectively. Epilepsy patients were not significantly more likely to be hospitalized than patients without epilepsy.

### Portal usage and clinic utilization

Race, number of prescriptions, scheduling area, diagnosis, and portal user status were significant predictors of increased clinic utilization. Demographically, black patients were significantly more likely than white patients to be hospitalized (OR = 1.27), while there was no significant difference in likelihood between white and other patients. Neurology clinic patients used the clinic less often than Movement Disorders clinic patients (OR =

0.89) (Table 4). Diagnoses of multiple sclerosis or epilepsy were associated with increased clinic utilization rate by about 50 percent, while a diagnosis of epilepsy was associated with an increase in clinic utilization rate by only 31 percent. Notably, while holding all other variables constant, portal users on average had a 31 percent higher rate of clinic utilization.

## Discussion

In our study of portal use among neurology patients of a large academic medical center, we found that portal users were most likely to be White, non-Hispanic, younger female individuals living within 20 miles of our center, with a diagnosis of multiple sclerosis or Parkinson's and seen at the general neurology clinic (rather than the subspecialized movement disorders clinic). To our knowledge, our study is the first to demonstrate interaction effects between age/sex and age/race in patient portal usage. Our findings were otherwise consistent with prior studies that found minorities, particularly African Americans and Hispanics, to be less likely to use patient portals.<sup>13,20,22,25–28</sup> Regarding age, some studies have found that portal users were older and had more comorbidities,<sup>17</sup> while others reported that diabetes<sup>11</sup> and multiple sclerosis<sup>29</sup> patient portal users were younger. In an academic medical center-based study similar to ours, the general patient population of portal users was more likely to be young, female, and Asian; age, race, and gender interactions were not considered in this study.<sup>20</sup> Based on prior findings and our results, it seems likely that the relationship between age and portal usage varies depending upon the specific patient population and associated diagnoses.

Our results were also unique in examining patient portal usage across different diagnostic groups, showing that patients with multiple sclerosis or Parkinson's were significantly more likely to be portal users, while those with epilepsy were significantly less so. This difference suggests that patient sub-population needs should be considered when designing and promoting a patient portal since it is possible that patients with epilepsy did not consider the portal to be as useful as other groups, or they were not informed about it as much as other groups. Other factors to consider include variable efforts between subspecialties in encouraging their patients to portal use. More in-depth analysis would be needed to explain this discrepancy. Overall, our results suggest that internal analysis of portal use might be very helpful in promoting portal usage across service locations and demographics, but they do not provide conclusive evidence of improved health outcomes. Notably, black and Hispanic patients were least likely to use the portal but more likely to be hospitalized, indicating that other strategies might be of need for these populations.

Furthermore, being a portal user was associated with higher clinic utilization, consistent with findings of similar studies.<sup>14,16,17,29,30</sup> It is possible that portal users feel more empowered to schedule follow-up appointments through the portal. This might be especially important in a subspecialty clinic setting where visits are less frequent than in the primary care arena. Alternatively, more exposure to the clinic setting may increase desire to set up a portal. After adjusting for related factors, portal usage was not associated with odds of hospitalization in our neurology specialty population, contrary to prior study findings.<sup>17</sup> A limitation to this aspect of the study was that patients who lived farther away from the clinic

might seek emergency medical attention outside of our institution, without our ability to capture such data.

### Limitations

Our study benefited from the large sample size and, thus, was able to inform the local institution to consider methods for targeting low-usage groups, notably older female patients and black patients. However, this study was limited by its cross-sectional and retrospective nature, which only allows for examination of associations and limits the ability to evaluate potentially mediating factors like patient satisfaction. While this study may be a good representation of a neurology clinic population due to its large sample size, it should not be generalized to other outpatient settings as patient characteristics can differ greatly depending on context. For example, while the patient demographics were generally consistent with those of the surrounding county, which are predominantly non-Hispanic white (70%)<sup>31</sup> and non-Hispanic black (21%),<sup>31</sup> our population may not be representative of the general neurology patient population and may reflect lower proportions of Hispanic and black patients due to underlying differences in access to healthcare.

Another aspect to be pointed out is that the number of medications reported was low (0–2); given that this number is self-reported, it might have resulted from underreporting, reporting of subspecialty medications only, or the population being underserved. Furthermore, while all variables under study were significantly associated with portal usage likelihood, the ROC of the models suggests that determinants of portal usage are likely to include other factors that were not available in this data set, such as socioeconomic status and disability level.

In addition, since portal usage did not appear to be associated with lower clinic utilization or hospitalization and was not evenly distributed across user demographics, it may be beneficial for our institution to identify other innovative, proactive approaches to increase patient portal uptake. Earlier studies have suggested that minority and older patients may have disproportionate access to computers and the Internet to access their portal, although this divide is becoming less of a concern with the proliferation of inexpensive smartphones.<sup>13,32</sup> Several interventions have been suggested to reduce the utilization disparity among demographic subgroups. Providers are likely to play an influential role by encouraging their patients to activate and utilize the portal, highlighting the benefits to the patient and alleviating possible concerns regarding confidentiality and security of patient data.<sup>7,11,13</sup> Institutional efforts could include working with the health information technology (HIT) vendor to improve portal design, making it appropriate for lower level literacy, particularly those functionalities that patients report using the most.<sup>7</sup> Infographics and educational flyers distributed to patients could further promote the functionalities and benefits of the patient portal.<sup>13</sup>

In conclusion, our study provides novel, helpful insights into electronic patient portal use within a neurology subspecialty population. The data gained from our study, in comparison with other studies on the topic, suggest that demographic and local characteristics and differences may drive a large part of the portal use, and would call for internal analysis in practices using portals to make best use and adjustments according to findings. Our methods can also be used by other institutions looking to evaluate portal uptake and outcomes within

their own settings, as our findings may be limited in generalizability due to the multitude of variable individual-level and external factors which may influence results.

Future studies may consider examining patient satisfaction as a potential mediator between portal usage and improved outcomes. In addition, focus groups could provide valuable feedback on how to improve portals for different categories of patients, building upon existing recommendations and addressing known barriers to portal enrollment and active engagement.<sup>24,33</sup> Overall, more research is needed to quantify the impact of patient portals and identify ways to improve portal adoption among varying patient populations.

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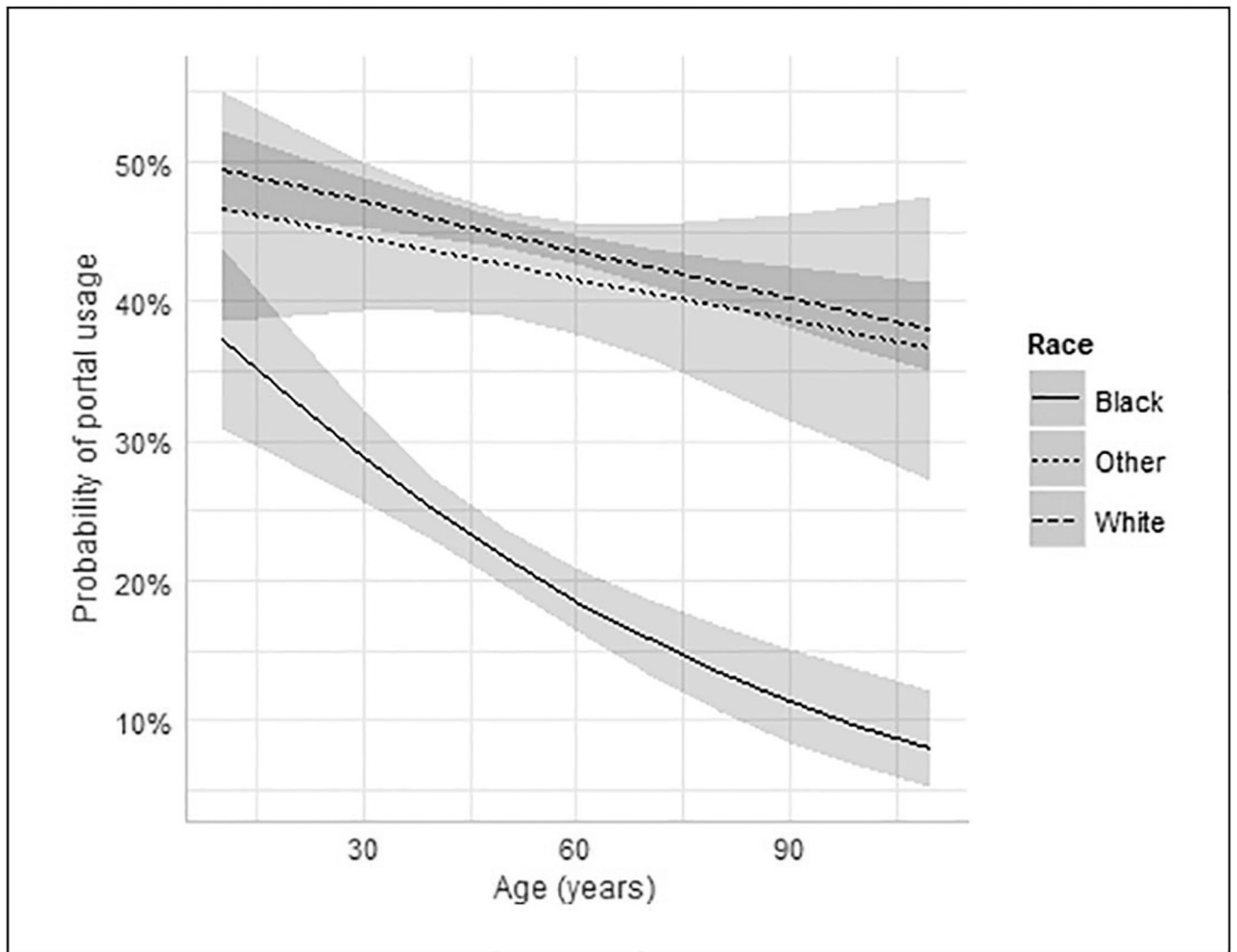
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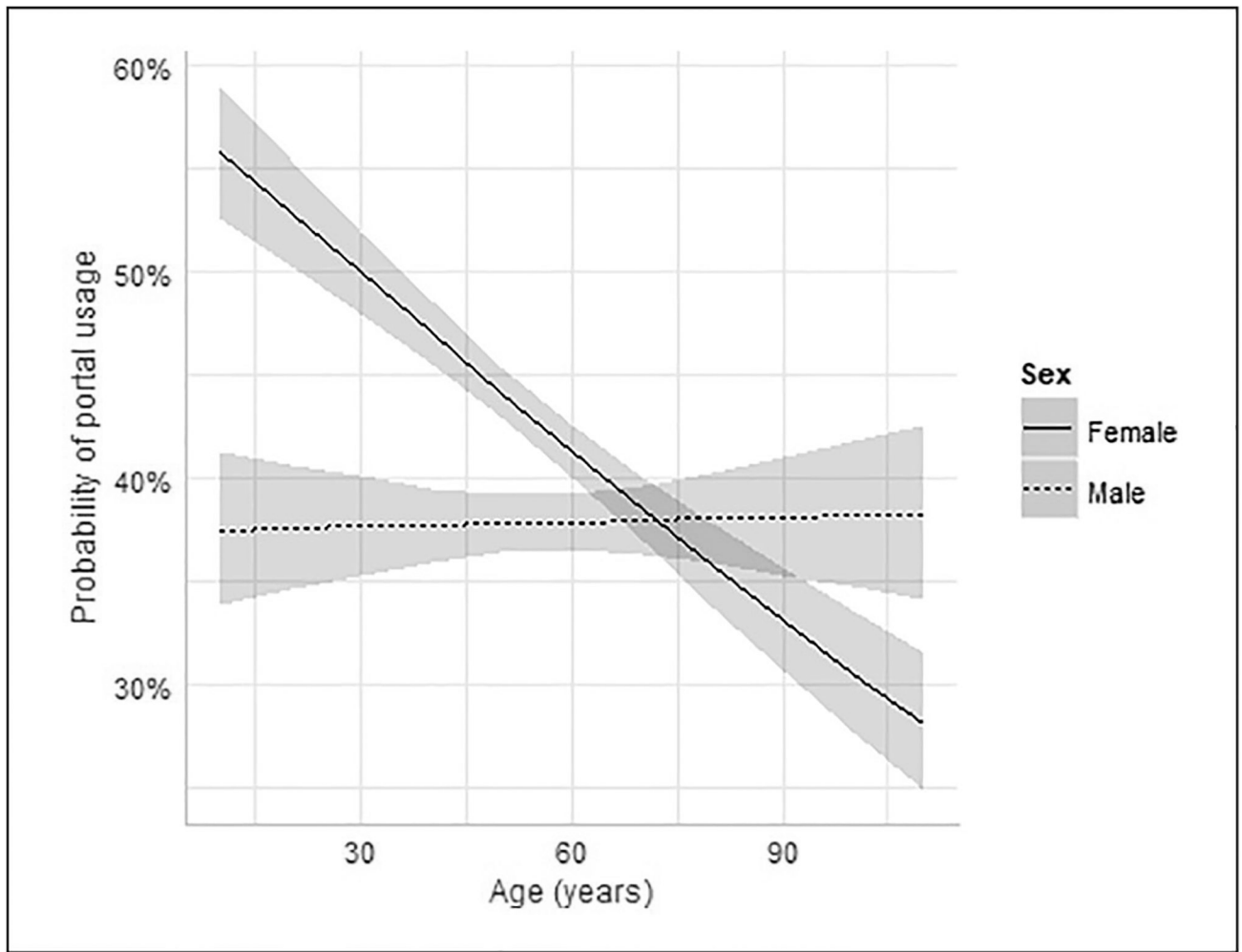
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**Figure 1.**  
Probability of patient portal usage by age and race.



**Figure 2.** Probability of patient portal usage by age and sex.

**Table 1.**

## Sample characteristics.

<b>Portal user status</b>	<b>User 5,648 (41.9%)</b>	<b>Non-user 7,835 (58.1%)</b>	<b>All 13,483 (100.0%)</b>
Age (years)	54.3 ± 17.7	55.6 ± 18.4	55.1 ± 18.1
Sex			
Female	3,299 (43.7%)	4,247 (56.3%)	7,546 (56.0%)
Male	2,349 (39.6%)	3,588 (60.4%)	5,937 (44.0%)
Race			
White	4,784 (44.7%)	5,921 (55.3%)	10,705 (79.4%)
Black	466 (27.6%)	1,221 (72.4%)	1,687 (12.5%)
Other	366 (43.5%)	476 (56.5%)	842 (6.2%)
Missing	32 (12.9%)	217 (87.2%)	249 (1.9%)
Ethnicity			
Non-Hispanic	5,388 (42.6%)	7,263 (57.4%)	12,651 (93.8%)
Hispanic	225 (38.7%)	356 (61.3%)	581 (4.3%)
Missing	35 (13.9%)	216 (86.1%)	251 (1.9%)
Distance from clinic (miles)			
0–20	2,079 (50.9%)	2,002 (49.1%)	4,081 (30.3%)
21–50	1,236 (37.4%)	2,063 (62.5%)	3,299 (24.5%)
51–100	1,035 (36.8%)	1,775 (63.2%)	2,810 (20.8%)
>100	1,298 (39.4%)	1,995 (60.6%)	3,293 (24.4%)
Diagnosis			
Parkinson's disease	837 (48.2%)	901 (51.8%)	1,738 (12.9%)
Epilepsy	531 (37.3%)	889 (62.6%)	1,420 (10.5%)
Multiple sclerosis	161 (51.8%)	150 (48.2%)	311 (2.3%)
Other or no diagnosis	4,207 (41.7%)	5,885 (58.3%)	10,092 (74.8%)
Scheduling area at 1st visit			
General neurology	4,052 (42.5%)	5,480 (57.5%)	9,532 (70.7%)
Movement disorders	1,596 (40.4%)	2,355 (59.6%)	3,951 (29.3%)
Number of prescriptions at 1st visit			
0	2,639 (40.6%)	3,866 (59.4%)	6,505 (48.3%)
1–2	1,920 (51.7%)	1,794 (48.3%)	3,714 (27.6%)
3–4	829 (57.2%)	621 (42.8%)	1,450 (10.8%)
5 or more	1,220 (67.3%)	594 (32.7%)	1,814 (13.5%)
Number of clinic visits			
1	2,425 (34.6%)	4,584 (65.4%)	7,009 (52.0%)
2–3	2,439 (48.1%)	2,636 (51.9%)	5,075 (37.6%)
4–5	613 (55.8%)	486 (44.2%)	1,099 (8.2%)
6 or more	129 (43.0%)	171 (57.0%)	300 (2.2%)

**Table 2.**

Odds ratio estimates—portal usage (Model ROC = 0.66).

<b>Effect</b>	<b>Point estimate</b>	<b>95% confidence limits</b>	
Distance 21–50 miles vs. 0–20 miles	0.51	0.46	0.56
Distance 51–100 miles vs. 0–20 miles	0.50	0.45	0.55
Distance > 100 miles vs. 0–20 miles	0.57	0.52	0.64
Ethnicity—Hispanic vs. not Hispanic	0.70	0.57	0.85
Number of prescriptions at 1st visit	0.97	0.96	0.98
Scheduling area—general neurology clinic vs. movement disorders	1.34	1.21	1.48
Multiple sclerosis vs. no multiple sclerosis	1.34	1.05	1.71
Epilepsy vs. no epilepsy	0.70	0.62	0.79
Parkinson's disease vs. no Parkinson's disease	1.64	1.44	1.87
Count of clinic visits over study time period	1.26	1.22	1.29

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**Table 3.**

Odds ratio estimates—hospitalization (Model ROC = 0.69).

<b>Effect</b>	<b>Point estimate</b>	<b>95% confidence limits</b>	
Distance 21–50 miles vs. 0–20 miles	1.05	0.94	1.18
Distance 51–100 miles vs. 0–20 miles	0.76	0.67	0.87
Distance > 100 miles vs. 0–20 miles	0.63	0.54	0.73
Hispanic vs. non-Hispanic	1.38	1.07	1.78
Number of prescriptions (1st visit)	0.88	0.86	0.90
General neurology patient vs. movement disorders	2.19	1.88	2.54
Count of clinic visits	1.17	1.13	1.21
Multiple sclerosis vs. no multiple sclerosis	0.61	0.43	0.89
Epilepsy vs. no epilepsy	1.04	0.90	1.21
Parkinson's disease vs. no Parkinson's disease	0.77	0.62	0.96
Portal user vs. non-user	1.04	0.94	1.15

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**Table 4.**

Rate ratios—clinic utilization.

<b>Effect</b>	<b>Rate ratio</b>	<b>Lower confidence limit</b>	<b>Upper confidence limit</b>
Epilepsy vs. no epilepsy	1.50	1.41	1.59
Multiple sclerosis (MS) vs. no MS	1.52	1.34	1.72
Number of prescriptions (1st visit)	0.99	0.98	0.99
Parkinson's disease (PD) vs. no PD	1.31	1.22	1.41
Black vs. white	1.27	1.06	1.53
Other vs. white	0.92	0.72	1.17
Neurology vs. movement disorders patient	0.89	0.84	0.95
Portal user vs. portal non-user	1.31	1.26	1.36

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